

CAYMAN SECTION 4 PHASE 2

**SUBMITTED TO DRAINAGE
BOARD SEPTEMBER 1, 2015**

APPROVED

SEP 01 2015

**VANDEBURGH COUNTY
DRAINAGE BOARD**

Cayman Section 4 Phase 2-FINAL DRAINAGE PLAN

13.04.095 Conditions of drainage plan approval.

In order for an applicant to obtain approval of a final drainage plan, the following requirements must be met:

- A. The applicant shall be eligible under the terms of this chapter to apply for and obtain drainage plan approval.
- B. The drainage plan and supporting submittals required by this chapter shall have been prepared and submitted in a timely and proper manner in accordance with the provisions of this chapter. **Final Drainage Plan submitted on 3/31/2015 Revisions submitted on 8/17/2015**
- C. The drainage plan and supporting submittals shall reflect compliance with the requirements of this chapter, and compliance with any conditions of approval applied to the plan by the drainage board. **Required Revisions are shown in red.**
- D. The submitted data shall be gathered, analyzed, assembled into the drainage plan and supporting submittals; and shall be certified, and presented to the drainage board all by a civil engineer or land surveyor regularly engaged in stormwater drainage design, and registered to practice in the state of Indiana.
- E. An easement has been dedicated to house any off-site drainage facilities if such facilities are required to serve the project's stormwater drainage system. **No Offsite Easements Required**
- F. The person, persons, partnership, corporation, or other entity to whom approval of the drainage plan is granted must be the person, persons, partnership, corporation, or entity who will be responsible for accomplishing the project for which the drainage plan is developed. **Deer Valley Subdivision, LLC, Jagoe Homes, Inc., 3624 Wathens Crossing, Owensboro, KY 42301, 1-270-684-0639**

13.04.125 Building permits conditioned.

The Vanderburgh County building commissioner shall not allow construction of buildings, or other impervious structures or facilities to commence at the site of a project requiring final drainage plan approval until:

- A. Such approval has been expressed by the drainage board;
- B. And all storm drainage facilities are constructed. **See comment under Section 13.04.130**

13.04.130 Phased development of large projects allowed.

Large projects may be divided into phases for the purpose of constructing drainage facilities and obtaining permits in accordance with the requirements of this chapter. **Please describe if all facilities**

will be constructed prior to the construction of any buildings or if the project is to be phased. If the project is to be phased, please describe what facilities will be constructed prior to proceeding forward the development of groups of lots and construction of streets. All dirt work including relocation and expansion of basin to be completed. Streets and infrastructure to be installed in 3 phases-see revised submittal

13.04.160 Contents of preliminary drainage plan.

The comments and responses for the preliminary drainage plan are part of the approved preliminary drainage plan dated February 3, 2015. Proceed to 13.004.165 for review of final drainage plan

A. The contents of the preliminary drainage plan shall include a map based on the most current county planimetric maps, or a topographic map prepared from a more recent aerial photo reconnaissance that provides more accurate data, complete with contour lines, and showing the following:

1. The extent and area of each watershed affecting the design of the drainage facilities for the project; **Provided**
2. The soil types based on the most current information available from the SWCD; **Soil map with description of soil was provided. Soils consist of Hosmer, Wilbur and Henshaw.**
3. Zone "A" floodplain based on the current FIRM panels; **Provided. Small amount of area on the eastern portion of the proposed subdivision where the retention pond is located is shown within the 100 year zone.**
4. The existing man-made and natural waterways, ponds, basins, pipes, culverts, and other drainage facilities or features within or affecting the project; **There is an existing USCOE jurisdictional waterway that flows west to east through the northern portion of the project. This stream is to be relocated. A preliminary layout of the relocation was provided. The site also contains a couple of small wetlands. A permit application has been submitted to USCOE and IDEM. These agencies could request changes that may affect the final design of the drainage within the subdivision. The County has no issues with the submitted drainage plan with regard to these issues. Approval of the Drainage Plan does not relieve the applicant of receiving final approval from these agencies.**
5. The preliminary layout and design of the streets, and all stormwater drainage facilities, including depressed pavements used to convey or temporarily store overflow from the heavier storms, and all outlets for the storm water drainage facilities; **Drains on Bermuda Court spaced farther than allowed 600'. Additional drains shown in revision**
6. The existing streams, floodways, and floodplains to be maintained, and new channels to be constructed, their locations, cross sections, profiles, and materials used; **Need information on individual swales within subdivision (proposed flow rates for each swale). Provided in**

submitted revisions. How will drainage be handled on lots 425-430? There was a temporary offsite easement on the area of these lots that will cease to exist once this area is platted. Lots 227-231 in phase 2 do not appear to have a sufficient easement width to handle the drainage from these lots. Additional Easement shown.

7. The proposed culverts and bridges to be built, with the specific materials to be used, elevations, waterway openings, and the basis of their design; **Need information on individual pipes (sizes and material) within subdivision (elevations not required at this time). Provided on 2/2/2015 submittal**

8. Existing detention basins or ponds within the project, or outside the project but affecting it, to be maintained, enlarged, or otherwise altered, together with any new basins or ponds to be built; and their basis of design; **Offsite area of 108.72 acres will pass through the site in new channel. The Q_{25} for this area is 200.8 cfs. Previous portions of the site leaving undetained- Q_{25} of 41.14 cfs along Kansas Road, Q_{25} of 6 cfs along Kansas Road (east) Q_{25} of 6.85 cfs to Stone Crest=53.99 cfs. The calculated release rate for pass through was reduced by taking $200.8\text{ cfs} - 53.99 = 146.81$. An undeveloped rate Q_{10} for 44.25 acres was determined to be 70.54 cfs. This area is somewhat smaller than the area that will be draining to the final pond. Q allowable was determined to be Q_{25} pass through (146.81 cfs) + Q_{10} allowable (70.54 cfs) = 217.35 cfs. Proposed release rate is 177.99 cfs. Basin was sized utilizing 124 cfs which is per the previously approved plan. Please correct text to reflect this sizing. Text revised**

9. The estimated depth and amount of storage required of the basins and ponds, and their available freeboards; **Stage storage diagrams provided. The provided diagrams show that the basin will store the 25 and 100 year storms.**

10. The estimated location and percentage of impervious surface existing and expected to be constructed at completion of the project. **Provided for total subdivision**

11. Any interim plan which is to be incorporated into the project pending its completion according to the final drainage plan. **Submittal states that remaining subdivision will be constructed in phases with first phase to be lots 300-324.**

B. Notations and Explanations on the Preliminary Plan. All notations necessary to indicate the existing conditions, and the proposed functions of the various features shown thereon; and shall include the following.

C. Geographic Orientation Required. A north arrow, scale, location insert, and other information necessary for geographic clarification shall be included on a preliminary plan. **Provided**

D. Data Required to Accompany Preliminary Plan. Descriptive data sufficient to support the feasibility of the preliminary drainage plan with regard to the requirements of this chapter, including calculations of the

predevelopment and post development runoff rates using rainfall data supplied herein shall accompany a preliminary drainage plan.

Drainage Plan should discuss timing of construction of basin in relation to the development of the lots. Will the basin be completed and functional prior to construction of any homes or will it be constructed in phases?

***Please provide information regarding developer (Name of firm and contact information).
Jago Homes, Inc., 3624 Wathens Crossing, Owensboro, KY 42301, 1-270-684-0639***

Though not required for this submittal, the final drainage plan should address how the drainage from the back lots of 387-389 will be addressed.

These lots will drain back to front. Side yard easements have been added.

13.04.165 Contents of the final drainage plan.

The contents of the final drainage plan shall include all the items listed above for a preliminary drainage plan, plus:

- A. Soils Map. A soils map indicating soils names and their hydrologic classification must be provided for a proposed project. **Provided-soils consist of Hosmer, Wilbur and Henshaw**
- B. Location and Topographic Map. In addition, a location and topographic map must be provided showing the land to be developed, and such adjoining land whose location and topography may affect or be affected by the layout or drainage of the project. **Provided**
- C. Contour Intervals.
 - 1. The contour intervals shown on the topographic map shall be two and one-half feet for slopes less than four percent; and five feet for slopes four percent or greater; or best available; **1'**
Contours
 - 2. The location of streams and other stormwater conveyance channels, both natural and man-made; and the vertical and horizontal limits of the one hundred (100) year floodplain, according to FIRM panels, and/or the building commissioner; all properly identified; . **FIRM Map provided-small amount of area on the extreme east end near the basin is within 100 year zone.**
 - 3. The normal shoreline of lakes, ponds, swamps, and basins, their floodplains, and lines of inflow and outflow;
 - 4. The location of exiting regulated drains, farm drains, inlets and outfalls; **Per submittal, none exist**

5. Storm, sanitary, and combined sewers, and outfalls; **No Combined Sewers-Plans submitted that show location of sanitary sewers. All storm sewers shown. Two HDPE pipes are shown that are to be removed.**
6. Wells, septic tank systems, and outfalls, if any; **Per submittal, none known to exist**
7. Seeps, springs, sinkholes, caves, shafts, faults, or other such geological features visible, or of record; **Per submittal, no geological features are visible or of record**
8. The limits of the entire proposed project and the limits of the expected extent of land disturbance required to accomplish the project
9. The location of the streets, lot lines, and easements; **Provided-many easements are variable and additional information will need to be provided**

The easement on the north side of the property at the location of the relocated channel needs to be changed to a conservation easement with the proposed language that will be submitted to the USCOE for approval. It should be noted that Vanderburgh County will NOT have any rights to amend the approve USCOE language nor allow any encroachments within this easement without USCOE approval. Drawings revised to show Conservation Easement

Will the USCOE conservation easement affect or be part of the retention pond and if so will affect the ability to maintain the pond to Vanderburgh County Drainage Ordinance requirements? To be addressed with submittal of plat

10. A scale, preferably one inch equals fifty (50) feet; **1"=80'**
11. An arrow indicating North. **Provided**

D. On-Site Bench Mark Required. A benchmark determined by "Mean Sea Level Datum 1929," is required to be located within the project limits. **None Shown Shown on revised drawing C-101**

13.04.170 Final drainage plan layout.

A. In addition to the requirements listed for a preliminary drainage plan, the final drainage plan shall depict the following:

1. The extent and area of each watershed tributary to the drainage facilities within the project; **Provided**
2. The final layout and design of proposed storm sewers, their inlet and outfall locations and elevations, the receiving streams or channels; all with the basis of their design; **Provided**

3. The location and design of the proposed street system, including depressed pavements used to convey or detain overflow from storm sewers and over-the-curb runoff resulting from heavier rainstorms, and the outlets for such overflows; all with their designed elevations;
4. The locations, cross sections, and profiles of existing streams, floodways, and floodplains to be maintained, and the same for all new channels to be constructed **It appears that the back drainage from lots 372 to 385 is to be conveyed utilizing an existing ditch. Also, swale 13 is shown to drain into this ditch. Please provide additional information regarding this ditch. Will the ditch as it currently exists carry the required flows? Will any additional drainage be carried on neighboring lots? Provided cross section B-B**

There is no design information regarding the swale between Verona Court and Road and services subbasin #30; please provide. Provided

There are a number of swales (for example swale #2) that have average slopes less than 4%, yet on the topography maps it appears that short sections of these swales may have slopes greater than 6%. The plans to need specify how section 13.04.360 will be met so that swales will be sodded or contain rip rap depending upon their slopes. Addressed in email dated 8/25/2015

What is the design criteria for the relocated channel as submitted to USCOE? Provided

5. The materials, elevations, waterway openings, size, and basis for design of the proposed culverts and bridges; **Provided**
6. Existing ponds and basins to be altered, enlarged, filled, or maintained; and new ponds, basins, swales, to be built, and the basis of their design **One existing basin which is to be expanded. Offsite area of 108.72 acres will pass through the site in new channel. The Q_{25} for this area is 200.8 cfs. Previous portions of the site leaving undetained- Q_{25} of 41.14 cfs along Kansas Road, Q_{25} of 6 cfs along Kansas Road (east) Q_{25} of 6.85 cfs to Stone Crest=53.99 cfs. The calculated release rate for pass through was reduced by taking $200.8 \text{ cfs} - 53.99 = 146.81$. An undeveloped rate Q_{10} for 44.25 acres was determined to be 70.54 cfs. This area is somewhat smaller than the area that will be draining to the final pond. Q allowable was determined to be Q_{25} pass through (146.81 cfs) + Q_{10} allowable (70.54 cfs) =217.35 cfs. Proposed release rate is 177.99 cfs which is the 53.99 undetained plus 124 cfs which is designed outlet pipe discharge. This total discharge of 177.99 is less than the Q allowable of 217.35. forper the previously approved plan. Describe timing of proposed enlarging of basin. The submittal for Phase 4 Section 1 showed that the basin as existed would handle the development of lots 300-324. Will the basin be expanded/completed prior to the development of additional lots beyond 300-324? Per revision, yes**

Swale 11 is to carry drainage from developed subbasin 5 in addition to outflow from pipe 543. There is no information provided regarding subbasin 5 and therefore whether swale 11 is of sufficient size to carry the combined flow. Provided

7. The location and percentage of impervious surfaces existing and expected to be constructed;

Provided

8. The material types sizes slopes grades and other details of all the stormwater drainage facilities; **Provided**

9. The estimated depth and amount of storage required in the new ponds or basins, the freeboard above the normal pool and highwater pool of wet basins, and details of the emergency overflows from the basins **Provided**

10. For all controlled release basins, a plot or tabulation of the storage volumes with corresponding water surface elevations, and a plot or tabulation of the basin outflow rates for those water surface elevations; **Provided-outflow for 25 year developed 124 cfs**

11. The location of any applicable “impacted drainage areas” or other areas designated to remain totally undisturbed, natural, or for common and/or recreational use. **None shown**

B. Protection of Structures From One Hundred Year Flooding. All structures to be occupied as residences or businesses shall have finished floor elevations two feet above the high water calculated to occur during a one hundred (100) year return period storm for the subject building site; and the required floor elevations shall be depicted on the plan drawings for such affected sites. **Building pad elevations are provided for each lot**

13.04.175 Submittal of a written drainage design report.

The final drainage plan shall be accompanied by a written report containing the following:

A. Any significant stormwater drainage problems existing or anticipated to be associated with the project; **The Preliminary Drainage Plan indicated an existing USCOE jurisdictional waterway that flows west to east through the northern portion of the project. This stream is to be relocated. A preliminary layout of the relocation was provided. Provide discussion on the development of the Section 4 phase 2 in relation to the timing of this relocation. All dirt work including relocation and expansion of basin to be completed. Streets and infrastructure to be installed in 3 phases-see revised submittal**

B. The analysis procedure used to identify and evaluate the drainage problems associated with the project; **Rational**

- C. Any assumptions or special conditions associated with the use of the procedures, especially hydrologic or hydraulic methods, used to identify and evaluate drainage problems associated with the project; **Provided**
- D. The proposed design of the drainage control system; **Provided**
- E. The results of the analysis of the proposed drainage control system showing that it does solve the project's identified and anticipated drainage problems; **Provided-the total discharge of 177.99 is less than the Q allowable of 217.35.**
- F. A detailed description, depiction, and log of all hydrologic and hydraulic calculations or modeling, and the results obtained thereby; together with the input and output files for all computer runs; **Provided**
- G. Maps showing individual drainage areas within the project subdivided for use in the analysis thereof **Provided**

13.04.180 Typical cross sections of the drainage facilities.

One or more typical cross sections must be provided for each existing and proposed channel, basin, pond, or other open drainage facility, which cross sections **Existing Basin**

- A. Must show the elevation of the existing land immediately adjacent to all drainage facilities;
- B. Must show the high water elevations adjacent to all waterways and impoundments as expected from the one hundred (100) year storm in relationship to permanent structures

13.04.440 General detention/retention basin design requirements.

The following design principles shall be observed for detention and retention basins:

- A. Duration of Storage. The maximum volume of water stored and subsequently released at the design release rate shall not result in a storage duration in excess of forty-eight (48) hours, unless additional storms occur within the period **Provided on detention facility design calculation sheet**
- B. Depth of Stored Water. The maximum depth of stormwater to be stored, without a permanent pool shall not exceed four feet; and the maximum depth of stormwater to be stored above a permanent pool shall not exceed four feet. **Provided for expanded basin; less than 4'**
- C. Basin Distance From Dwellings. All stormwater detention facilities shall be separated by not less than fifty (50) feet from any building or structure to be occupied by humans. **Unless a Variance is requested, no building may be built within 50' of the lake Variance Requested**
- D. Earthen Side Slopes 4:1 Maximum Steepness for Basins. All detention and retention basins with grassed, earthen side slopes shall have side slopes no steeper than four horizontal units of measurement to one vertical unit of measurement (4:1) to the base of dry basins, and to the typical low waterline of wet basins. **Basin partially constructed-plans show basin designed to meet this criteria**

E. Riprap Side Slopes 2:1 Maximum Steepness for Basins. Wet retention basins with riprap armored side slopes shall have slopes no steeper than two horizontal units of measurements to one vertical unit of measurement (2:1) at any point in the side slope. **Existing Basin**

F. Riprap to Extend Two Vertical Feet Below Waterline. The armored portion of the side slope must extend to a minimum depth below the permanent pool elevation of two vertical feet **No rip rap proposed**

G. Underwater Earthen Side Slopes 2:1 Maximum Steepness. Nonarmored earthen side slopes shall have slopes no steeper than two horizontal units of measurement to one vertical unit of measurements from a point two vertical feet below permanent pool, thence downward. **Basin partially constructed-plans show basin designed to meet this criteria**

H. Minimum Depth of Riprap Application. Riprap side slope armor shall be a minimum twelve (12) inches in depth at all points of application. **No rip rap shown**

I. Drain Recommended for Maintenance of Wet Basins. If possible, a drain should be installed to lower the pool of wet basins to a level sufficient to repair any wave action erosion along the waterline, and to perform other periodic maintenance. **Not provided nor is it required**

J. Safety Ledges and/or Fencing of Wet Basins. Safety fencing surrounding the basin, and/or shallow safety ledges shall be provided if deemed necessary by the design engineer or the board. **None provided**

K. Outlet Controls to Operate Automatically. Outlet control structures shall be designed to operate as simply as possible, and shall require little or no maintenance for proper operation. **No controls**

L. Designed Water Level Control Required. A controlled positive outlet shall be required to maintain the designed water level in wet basins, and provide the required detention storage above the designed low water level. **Basin partially constructed-plans show basin designed to meet this criteria**

M. Emergency Spillway Requirements.

1. An emergency overflow spillway shall be provided for the release of storm runoffs exceeding the designed maximum detention volume, or all overflow volumes in emergency conditions, should the normal discharge devices become totally or partially inoperative. **Basin will release through primary spillway during 100 year storm due to size of basin**

2. A minimum freeboard of one-half foot above the calculated elevation of the design storm detention high water level to the elevation of the spillway flowline peak is required as a safety factor for all basins. **When discharging, emergency overflow to carry 122 cfs at a depth of 0.5'**

N. Automatically Operating Emergency Spillway Required. The emergency overflow spillway shall be designed so that it operates openly, automatically, does not require manual attention, and will pass all the one hundred (100) year return period storm flow with a one-half foot vertical minimum above the one

hundred (100) year return storm flow to the lowest dirt elevation in the surrounding earthwork. **Basin will release through primary spillway during 100 year storm due to size of basin**

O. All Permanent Pools Require Water Quality Provisions. Designers of basins with permanent pools shall consult available manuals from the soil and water conservation district, and incorporate provisions therefrom for maintaining water quality, safety, and soil stability. **Provisions considered as discussed on Drawing C-114**

P. Dry Basin Cover and Maintenance. Dry basins shall be planted and maintained in vegetative cover equal to that of residential lawns **Wet Basin, not applicable**

Q. Side Slopes to Remain Stable. All side slopes of a basin shall be constructed stable and shall be maintained in a stable condition by the same criteria as specified herein for open channels. **Basin partially constructed-plans show basin designed to meet this criteria**

R. Wet Basin Cover and Maintenance. The earthen side slopes of wet basins shall be provided with grass cover above the low water elevation, which shall be maintained equal to turfed residential lawns, and in no case shall the cover growth exceed twelve (12) inches in height, or the most current county standard **Proposed seeding mixture listed on Drawing C-114**

S. Maintenance Pathway for Basins. A flat pathway with a minimum width of ten (10) feet shall be constructed completely around the top of the embankment of all detention/retention basins. **Basin partially constructed-plans show basin designed to meet this criteria**

T. Maintenance Easement for Basins. An easement dedicated for the purpose of accessing and maintaining the basin and its appurtenances shall be provided, and the easement shall be configured so that it includes the entire basin, the entire earthwork encompassing the basin, the maintenance pathways into and around the basin, and all inletting and outletting appurtenances of the basin. **Provided**

U. Maintenance Report Required for Basin.

1. A brief and concise report shall be prepared, by the design engineer, consisting of a description of the location, intended function of all parts appurtenant to the basin, together with a description of the ways in which the basin and its appurtenances should be maintained, all worded in language easily understood by residential or commercial property owners; and; **Discussed on Drawing C-114**

2. The report shall be attached to the restrictions for the property on which the basin and its parts are located.

3. Such restrictions shall be shown to exist prior to the board's final approval of the drainage plan for a project whose plans include a basin. **The drainage plan is being prior to final plat. See note under 13.04.460.**

V. Copy of Report Must be Submitted With the As-Builts. A copy of the maintenance report described above shall be included with the as-built plans required to be submitted hereinabove.

W. Elevation of Dry Basin Bottom Marked. A continuous concrete liner at least equal in characteristics to that described in Section 13.04.315F shall be installed in all dry basins from the point of inflow of each channel entering a basin to the point of outflow from the basin. The concrete liner shall be installed at an elevation slightly lower than the earthen floor of the basin, so that it may serve as a trickle trough or low flow liner. **Wet Basin, not applicable**

13.04.460 Responsibility for drainage facility maintenance.

The installation, maintenance, repair, and replacement of all stormwater drainage facilities, and erosion and siltation control measures for a project during the period of construction, and until final approval by the county engineer, shall be the responsibility of the land developer(s), and/or the property owner(s) of record.

The assignment of responsibility for the maintenance and repair of all stormwater drainage systems and facilities outside of county accepted road rights-of-way after the completion of the project, and final approval thereof by the county engineer, shall be determined before the final drainage plan is approved; and shall be documented by appropriate covenants and restrictions applied to the subdivision and to the property deeds thereof, and shall be printed clearly upon all recorded plats of the project.

The Drainage Plan needs to address whether a Plan A (Lot Owners) or Plan B (Repair Fund held by County) will be utilized. Repair Plan B (noted on revised drawing C-101)



**CASH WAGGNER
& ASSOCIATES, PC**
CONSULTING ENGINEERS • LAND SURVEYORS

DATE: 03.30.15

ATTENTION: Jeff Mueller

PROJECT NO.: 14-1948

COMPANY: Vanderburgh County
Surveyor

REFERENCE: Cayman Ridge -
Section 4, Phase 2

ADDRESS: Civic Center Complex -
Room 325

YOUR FILE NO.:

CITY, ST, ZIP:
Evansville, IN 47708

PHONE:

THE FOLLOWING ITEMS:

COPIES:	ORIG./LAST REV. DATE:	DESCRIPTION:
1	03.11.15	Construction Plans
1	03.30.15	Final Drainage Report & Calculations

LETTER OF TRANSMITTAL

ARE TRANSMITTED:

- PER YOUR REQUEST
- FOR YOUR FILES
- FOR REVIEW & COMMENT
- OTHER

FOR YOUR:

- APPROVAL
- USE
- INFORMATION
- OTHER

VIA:

- COURIER
- FOR PICK UP
- USPS
- NEXT DAY
- FED EX
- UPS
- DHL
- SATURDAY DELIVERY
- TRACKING # _____
- OTHER DELIVERED

COMMENTS:

Please review the attached drainage plan and report and if acceptable take to next available Drainage Board meeting for Final Drainage Plan approval. If you have any questions or comments, please give me a call. Thank you

414 CITADEL CIRCLE
SUITE B
EVANSVILLE, IN 47715
PH: 812.401.5561
FAX: 812.401.5563
G.MERITT@CASHWAGGNER.COM

FROM:

GLEN MERITT, JR., P.E.

cc: File

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VANDERBURGH COUNTY
SURVEYOR'S OFFICE
3/31/15



CASH WAGGNER
& ASSOCIATES, PC
CONSULTING ENGINEERS • LAND SURVEYORS

March 30, 2015

Mr. Jeff Mueller
Vanderburgh County Surveyor
Room 325 Civic Center - 1 NW Martin Luther King Jr. Blvd.
Evansville, IN 47708

**RE: Final Drainage Report
Cayman Ridge - Section 4
Kansas Road
Our Project #: 14-1948**



Mr. Mueller:

Below is a summary of the drainage calculations for the above-referenced project.

SITE DESCRIPTION

This development consists of a single family residential subdivision with 132 lots and its associated improvements (i.e. roads, utilities). This project will be constructed in multiple phases and the entire property will be disturbed during construction of the subdivision. The first phase to be constructed will consist of Lots 300 - 324. The site is located on a 40.93-acre parcel that lies approximately 2700 feet west and 1000 feet north of the Highway 57 and Kansas Road intersection.

No regulated drains, inlets or outfalls exist on this site. Two 12" HDPE field tiles have been located on this site and will be removed during construction. One is located on the southeast side of the Massey Drive and Road #4 intersection on Lot 336 and 337. The other is located on Lot 341 and 342. No existing sanitary sewers, combined sewers or outfalls are located on this site. No known wells, septic tanks systems or outfalls exist on this site. No seeps, springs, sinkholes, caves, shafts, faults or other such geological features are visible or of record on this site.

The existing ditch located on the north end of the site will be relocated along the north property line within the proposed drainage easements shown on the Drainage Plan (See Sheet C-101). The remaining portion of the detention basin will be constructed at one time once the Army Corp and IDEM permits have been approved for the ditch relocation.

DRAINAGE PATTERNS

The existing site was previously utilized as a cultivated field. The entire site drains in a northeasterly direction and runoff sheet flows to an existing ditch located on the north end of the site. This ditch flows east to the east property line, continues across Stonecreek PUD subdivision before discharging to Firlick Creek.

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3/31/15

The 25-year and 100-year flows were calculated for the entire 75.33-acre subdivision development. The 75.33-acres includes Sections 1-3 that have already been constructed. A portion of this acreage will be allowed to runoff undetained and only 61.36-acres will be collected by the detention basin. This area is depicted on the attached Overall Developed Sub-basin Exhibit and designated as sub-basin #1. The 25-year and 100-year flows were also calculated for this acreage that will be captured by the detention basin. Section 4, Phase 2 was divided into 27 developed sub-basins with the 25-year and 100-year flows calculated for each sub-basin. See attached Developed Sub-basin Exhibit for the location of each sub-basin. There is one off-site sub-basin (Offsite A) west of our site that drains to the existing ditch which will also be captured by the detention basin. Another off-site sub-basin (Offsite B) is located at the southwest corner of the site and it is routed through a portion of the subdivision that has already been constructed and exits the site undetained. See attached Offsite and Undeveloped Drainage Sub-basin Exhibit for locations of each sub-basin. A drainage swale and storm sewer network will be installed within the development to capture the majority of the storm water runoff and convey it to detention basin #1 located along the east property line. The primary and emergency spillway of the detention basin will discharge to the existing ditch located at the southeast corner of the detention basin. Drainage easements have been provided on the side yards of Lots 386 - 389 to allow these lots to be graded from back to front.

CALCULATIONS

The Rational Method and HERPICC Manual were utilized in performing the drainage calculations for this project. All storm sewers and swales were designed to carry the 25-year developed runoff. Detention basin #1 was designed to contain the peak 25-year developed runoff from the site while allowing a release rate less than the peak 10-year undeveloped runoff rate from the site. The emergency spillway for the detention basin was designed to carry the 100-year storm flow.

Below is a summary of the detention basin design elements:

		NOTES
Detention Basin #1 Developed Q(25)	151.86 - cfs	
Detention Basin #1 Developed Q(100)	187.70 - cfs	
Detention Basin #1 Undeveloped Q(10)	70.55 - cfs	Undeveloped Sub-basin A
10/25-yr. Req'd Volume	324,973 c.f.	
Undetained Developed Q(25)	53.99 - cfs	#1 and #17
Off-Site Existing Q(25)	200.80 - cfs	Off-Site A
Allowable Release Rate	217.36 - cfs	Undeveloped Q(10) - Undetained Developed Q(25) + Off-Site Q(25)
<i>Proposed Detention Basin</i>	<i>124.00 - cfs</i>	<i>Detention Basin #1</i>



CASH WAGNER & ASSOCIATES, PC

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<i>Release Rate</i>		<i>Primary Spillway</i>
<i>Proposed Project Release Rate</i>	177.99 - cfs	<i>Detention Basin Discharge + Undetained Runoff</i>
<i>Outfall Structure</i>	40-LF 8' x 4' Concrete Box Culvert (Existing)	
Outfall I.E.	391.61	
25-year Storage Vol. Elev.	394.02	
HW (25-yr. elev. - I.E.)	2.41 - ft.	
Minimum Top/Bank	396.61	

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CASH WAGNER & ASSOCIATES, PC

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DETENTION FACILITY DESIGN VOLUME CALCULATIONS

PROJECT: Gayman Ridge
Section 4

DETENTION FACILITY DESIGN RETURN PERIOD: 25 YRS

RELEASE RATE RETURN PERIOD: 10 YRS

WATERSHED AREA: 170.08 ACRES
DEVELOPED RUNOFF COEFFICIENT (C_d): 0.482

STORM DURATION T _d (HRS)	RAINFALL INTENSITY I _d (INCH/HR)	INFLOW RATE I(T _d) (C _d *I _d *A) (CFS)	OUTFLOW RATE O (C _u *I _u *A) (CFS)	STORAGE RATE ΔS I(T _d)-O (CFS)	REQUIRED STORAGE S _d (I(T _d)-O)*T _d /12 (ACRE-FT)
0.08	7.208	590.90	124.00	466.90	3.242
0.17	5.925	485.72	124.00	361.72	5.024
0.25	5.033	412.60	124.00	288.60	6.012
0.33	4.571	374.70	124.00	250.70	6.964
0.42	4.108	336.80	124.00	212.80	7.389
0.50	3.646	298.89	124.00	174.89	7.287
0.58	3.385	277.47	124.00	153.47	7.460
0.67	3.123	256.05	124.00	132.05	7.336
0.75	2.862	234.62	124.00	110.62	6.914
0.83	2.601	213.20	124.00	89.20	6.194
0.92	2.339	191.78	124.00	67.78	5.177
1.00	2.078	170.35	124.00	46.35	3.863
1.25	1.909	156.46	124.00	32.46	3.381
1.50	1.739	142.56	124.00	18.56	2.320
1.75	1.570	128.67	124.00	4.67	0.680
2.00	1.400	114.77	124.00	-9.23	-1.538

PEAK STORAGE (ACRE/FT): 7.46
PEAK STORAGE (CUBIC FT): 324,973

$$\frac{324,973 \text{ ft}^3}{124 \text{ ft}^3/\text{sec}} = 2,621 \text{ sec.} \times \frac{1 \text{ min.}}{60 \text{ sec.}} \times \frac{1 \text{ hr.}}{60 \text{ sec.}}$$

$$= 0.73 \text{ hours to return to normal pool elevation.}$$

Cayman Ridge - Section 4

Detention Basin 1

PROVIDED DETENTION VOLUMES

(per ACAD)

	<u>Elevation</u>	<u>Area</u> <u>(s.f.)</u>	<u>Avg. Area</u> <u>(s.f.)</u>	<u>Inc. Vol.</u> <u>(c.f.)</u>	<u>Cumulative Vol.</u> <u>(c.f.)</u>
Pool	391.61	126,670			
	392.61	133,298	129,984	129,984	129,984
	393.61	140,027	136,663	136,663	266,647
	394.61	146,857	143,442	143,442	410,089
E.O.S.	395.61	153,787	143,543	143,543	553,631
T.B.	396.61	160,817	157,302	157,302	710,933

Detention volume provided at Elev. 395.75 = 553,631 c.f.

TOTAL DETENTION VOLUME PROVIDED = 553,631 c.f.

Total, required 25-YR detention volume = 324,973 c.f.

25-YR Req'd detention volume provided @ Elev. = 394.02 ft.

Req'd HW= 2.41 ft.

Detention volume provided at Elev. 396.75 = 710,933 c.f.

Total, required 100-YR detention volume = 485,471 c.f.

100-YR Req'd detention volume provided @ Elev. = 395.14 ft.

Req'd HW= 3.53 ft.

Weighted c calculations for sub-basins captured by Detention Basin

DEVELOPED WEIGHTED c CALCULATIONS			
			Total Area = 170.08 Acres
<i>Sub-basin</i>	<i>Area (A)</i>	<i>c</i>	<i>c x A</i>
#1	61.36 Ac.	0.521	0.188
Off-Site A	108.72 Ac.	0.460	0.294

Weighted c = 0.482

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No. 1 Overall

Total Area = 3,291,158 S.F.
75.33 Acres

Surface						C	N
Structures	261	@	2000	=	522,000 S.F.	=	11.98 Ac.
Drives	261	@	700	=	182,700 S.F.	=	4.19 Ac.
Pavement				=	300,000 S.F.	=	6.89 Ac.
Patios	261	@	100	=	26,100 S.F.	=	0.60 Ac.
Sidewalks				=	S.F.	=	0.00 Ac.
Lawn (0-2%)			0	S.F.	=	0.00 Ac.	0.12
Lawn (2-5%)			2,063,688	S.F.	=	47.38 Ac.	0.24
Lawn (5-10%)			0	S.F.	=	0.00 Ac.	0.36
Lawn (>10%)			60,000	S.F.	=	1.38 Ac.	0.48
Water			126,570	S.F.	=	2.91 Ac.	1.00
Misc.				S.F.	=	0.00 Ac.	0.92

Weighted c =	0.487
Weighted N =	0.265
Sheet Flow	
L =	300 Ft.
H =	3.0 Ft.
S =	0.0100 Ft./Ft.
t1 =	18.71 Minutes
Shallow Concentrated Flow	
L =	0 Ft.
H =	0.0 Ft.
S =	2.0000 Ft./Ft.
v =	3.80 Ft./sec.
t2 =	0.00 Minutes
Closed Conduit Travel Time	
From storm sewer spreadsheet	
t3 =	0.00 Minutes
tc =	18.71
I(10) =	0.000 In./Hr.
I(25) =	4.690 In./Hr.
I(50) =	0.000 In./Hr.
I(100) =	5.802 In./Hr.
Q(10) =	0.00 CFS
Q(25) =	172.17 CFS
Q(50) =	0.00 CFS
Q(100) =	212.99 CFS

(Min. 5 minutes)

(From HERPICC Figure 3.4.5)

DEVELOPED DRAINAGE BASIN CALCULATIONS

Basin No.: 1

Total Area = 2,672,312 S.F.
61.36 Acres

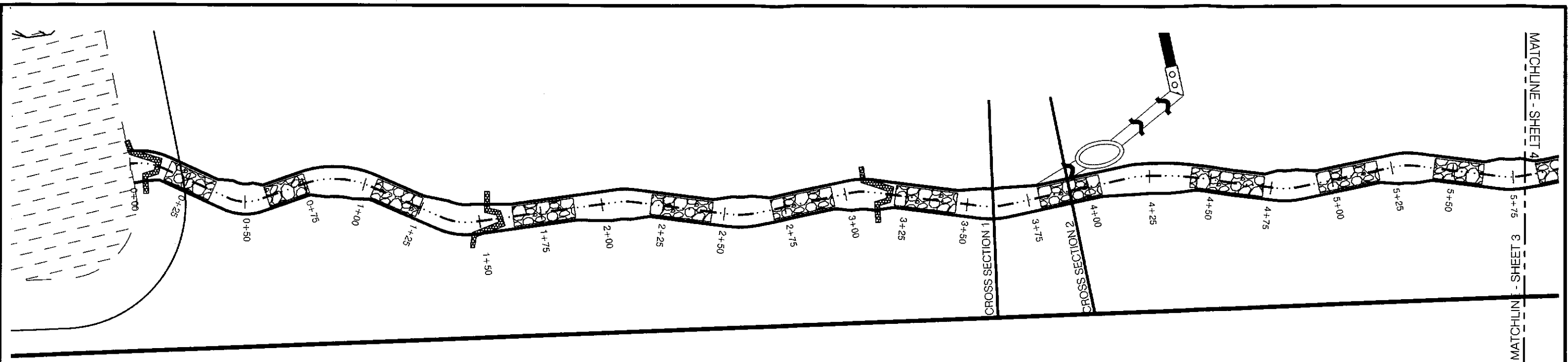
Surface						C	N	
Structures	213	@	2500	=	532,500 S.F. =	12.22 Ac.	0.92	0.02
Drives	213	@	700	=	149,100 S.F. =	3.42 Ac.	0.92	0.02
Pavement				=	240,725 S.F. =	5.53 Ac.	0.92	0.02
Pavlos	213	@	100	=	21,300 S.F. =	0.49 Ac.	0.92	0.02
Sidewalks				=	S.F. =	0.00 Ac.	0.92	0.02
Lawn (0-2%)			0 S.F.	=		0.00 Ac.	0.12	0.40
Lawn (2-5%)			1,542,547 S.F.	=		35.41 Ac.	0.24	0.40
Lawn (5-10%)			0 S.F.	=		0.00 Ac.	0.36	0.40
Lawn (>10%)			50,000 S.F.	=		1.38 Ac.	0.48	0.40
Water			126,670 S.F.	=		2.91 Ac.	1.00	0.00
Misc.				=		0.00 Ac.	0.92	0.02

Weighted c =	0.521
Weighted N =	0.247
Sheet Flow	
L =	300 Ft.
H =	3.0 Ft.
S =	0.0100 Ft./Ft.
t1 =	18.10 Minutes
Shallow Concentrated Flow	
L =	0 Ft.
H =	0.0 Ft.
S =	2.0000 Ft./Ft.
v =	3.80 Ft./sec.
t2 =	0.00 Minutes
Closed Conduit Travel Time	
From storm sewer spreadsheet	
t3 =	0.00 Minutes
tc =	18.10
i(10) =	0.000 In./Hr.
i(25) =	4.746 In./Hr.
i(50) =	0.000 In./Hr.
i(100) =	5.866 In./Hr.
Q(10) =	0.00 CFS
Q(25) =	151.86 CFS
Q(50) =	0.00 CFS
Q(100) =	187.70 CFS

(Min. 5 minutes)

(From HERPICC Figure 3.4.5)

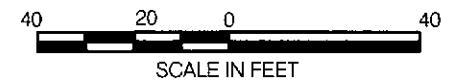
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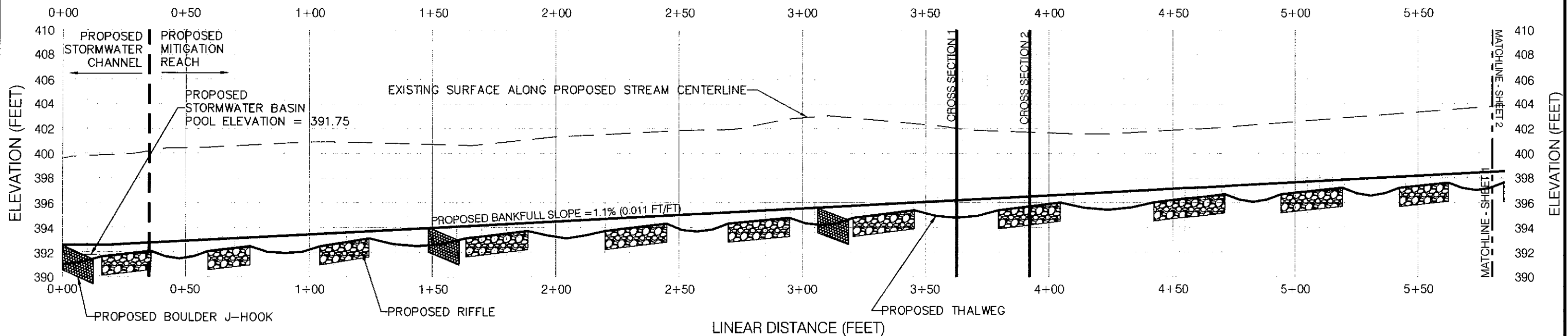
SOURCE: BASE MAP PROVIDED BY CASH WAGGNER AND ASSOCIATES

LEGEND

- | | | | | | |
|--|---------------------------------------|--|---|--|---------------------------------------|
| | PROPERTY BOUNDARY | | PROPOSED STORMWATER BASIN AT POOL ELEVATION | | PROPOSED CULVERT |
| | PROPOSED STREAM CENTERLINE | | PROPOSED RIFFLE | | PROPOSED ENERGY DISSIPATION FEATURE |
| | PROPOSED STREAMBANKS | | PROPOSED BOULDER J-HOOK | | PROPOSED STEP-POOL STORMWATER CHANNEL |
| | PROPOSED STORMWATER BASIN TOP OF BANK | | | | PROPOSED RIPARIAN DEPRESSIONAL AREA |



INTERMITTENT STREAM 1 LONGITUDINAL PROFILE



SCALE: HORIZONTAL 1" = 40'
VERTICAL 1" = 8'

CAYMAN RIDGE DEVELOPMENT
VANDERBURGH COUNTY, INDIANA



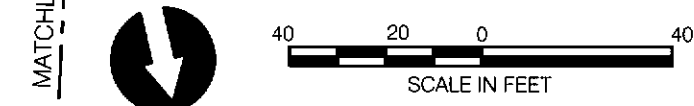
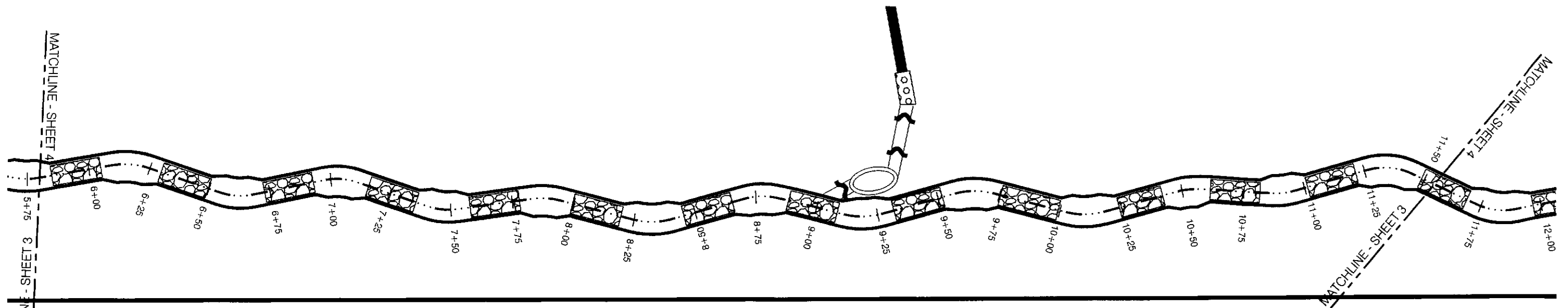
INTERMITTENT STREAM 1 -
PROPOSED PLANFORM
AND PROFILE

REVISED DATE: 01-15-15

DRAWN BY: BMB

FIGURE 8
SHEET 1 OF 3

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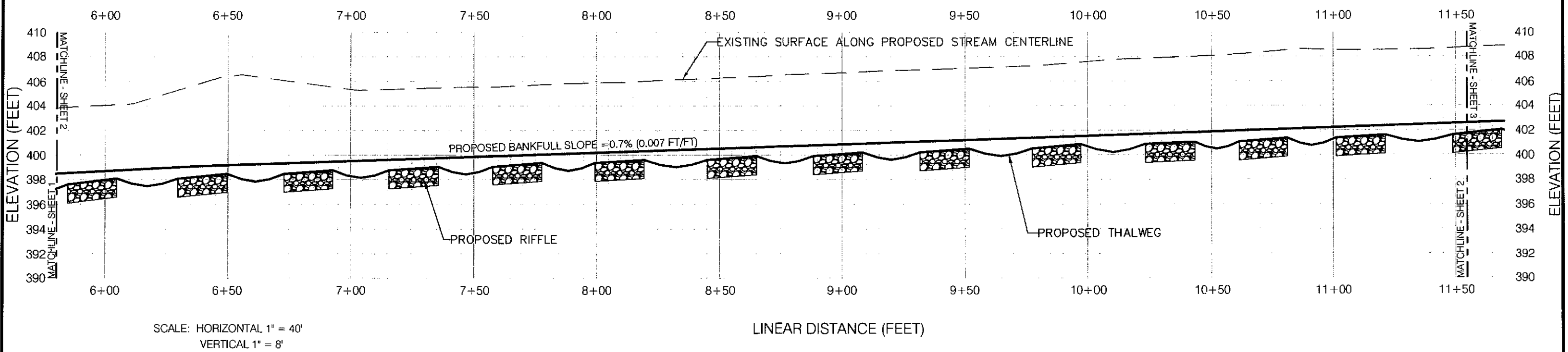


NOTE: JURISDICTIONAL WATERWETLAND BOUNDARIES WERE DELINEATED AND SURVEYED USING GLOBAL POSITIONING SYSTEM EQUIPMENT BY REDWING WETLAND SCIENTISTS ON NOVEMBER 24, 2014. THESE BOUNDARIES HAVE NOT BEEN VERIFIED BY THE U.S. ARMY CORPS OF ENGINEERS. USE OF THIS MAP IS FOR PRELIMINARY PLANNING PURPOSES ONLY. SOURCE: BASE MAP PROVIDED BY CASH WAGGNER AND ASSOCIATES

LEGEND

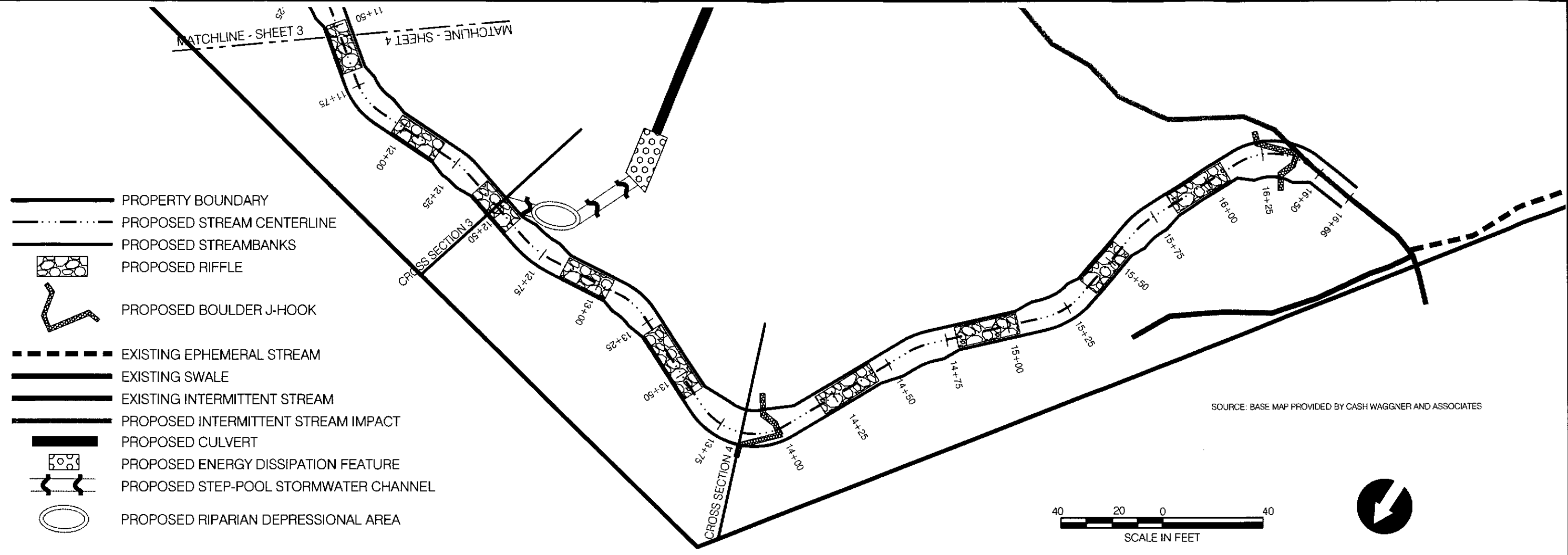
- PROPERTY BOUNDARY
- PROPOSED STREAM CENTERLINE
- PROPOSED STREAMBANKS
- PROPOSED RIFFLE
- PROPOSED CULVERT
- PROPOSED ENERGY DISSIPATION FEATURE
- PROPOSED STEP-POOL STORMWATER CHANNEL
- PROPOSED RIPARIAN DEPRESSIONAL AREA

INTERMITTENT STREAM 1 LONGITUDINAL PROFILE

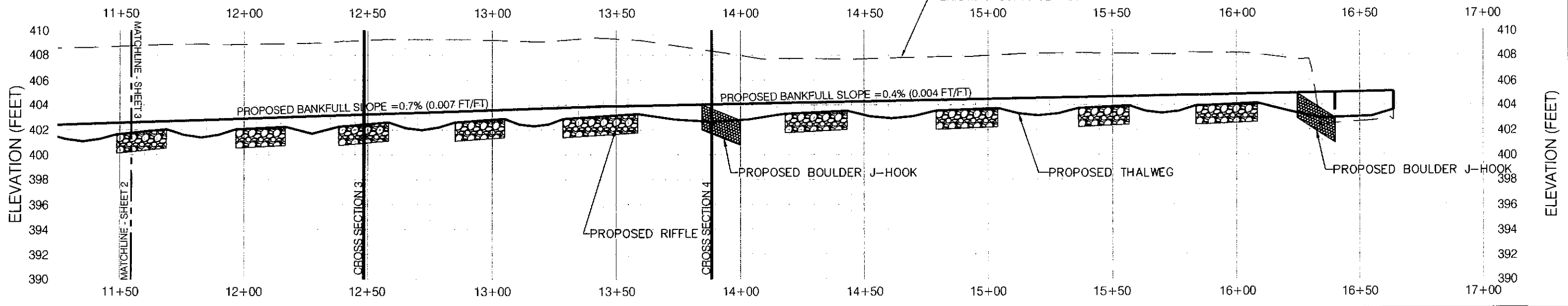


<p>CAYMAN RIDGE DEVELOPMENT VANDERBURGH COUNTY, INDIANA</p>	<p>REDWING ECOLOGICAL SERVICES, INC.</p>	<p>INTERMITTENT STREAM 1 - PROPOSED PLANFORM AND PROFILE</p> <p>FIGURE 8 SHEET 2 OF 3</p>
<p>REVISED DATE: 01-15-15</p>	<p>DRAWN BY: BMB</p>	

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INTERMITTENT STREAM 1 LONGITUDINAL PROFILE



SCALE: HORIZONTAL 1" = 40'
VERTICAL 1" = 8'

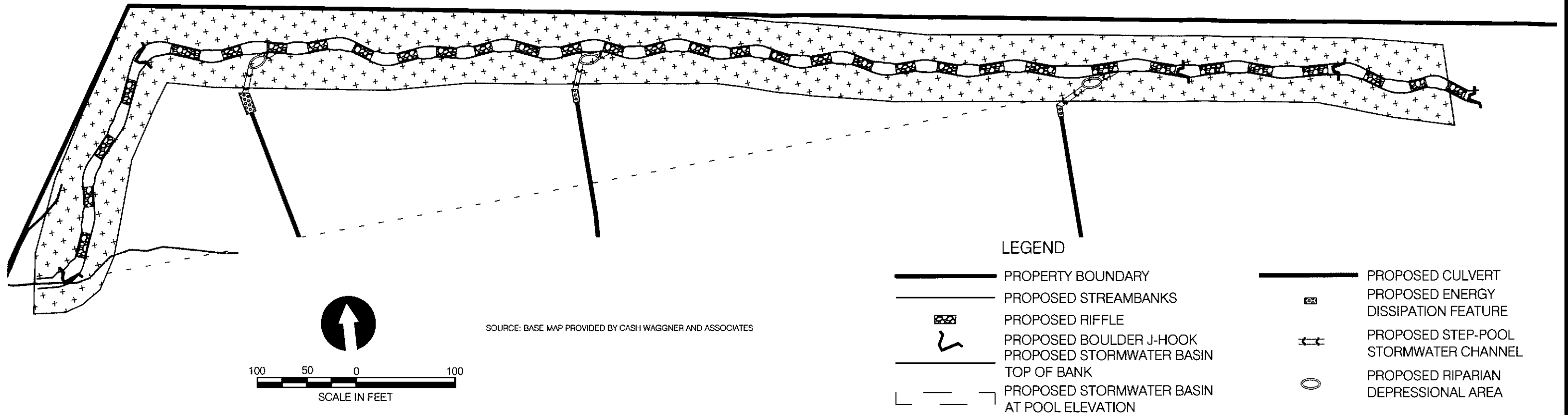
CAYMAN RIDGE DEVELOPMENT
VANDERBURGH COUNTY, INDIANA

REVISED DATE: 01-15-15 DRAWN BY: BMB



INTERMITTENT STREAM 1 -
PROPOSED PLANFORM
AND PROFILE

FIGURE 8
SHEET 3 OF 3



SOURCE: BASE MAP PROVIDED BY CASH WAGGNER AND ASSOCIATES

LEGEND

- PROPERTY BOUNDARY
- PROPOSED STREAMBANKS
- PROPOSED RIFFLE
- PROPOSED BOULDER J-HOOK
- PROPOSED STORMWATER BASIN
- TOP OF BANK
- PROPOSED STORMWATER BASIN AT POOL ELEVATION
- RIPARIAN PLANTING ZONE
- EXISTING INTERMITTENT STREAM
- PROPOSED INTERMITTENT STREAM IMPACT
- PROPOSED CULVERT
- PROPOSED ENERGY DISSIPATION FEATURE
- PROPOSED STEP-POOL
- STORMWATER CHANNEL
- PROPOSED RIPARIAN DEPRESSIONAL AREA

Table 1 - Native Grass Seeding List
Cayman Ridge Development Project
Vanderburgh County, Indiana

Scientific Name	Common Name	Planting Rate (lbs/ac)	Total Seed Mix (lbs)
<i>Agrostis albe</i>	Red Top Grass	2.5	6.5
<i>Elymus riparius</i>	Riverbank Wild Rye	5	13
<i>Elymus virginicus</i>	Virginia Wild Rye	5	13
<i>Lolium multiflorum</i>	Annual Ryegrass	20	52
<i>Panicum clandestinum</i>	Deertongue Panic Grass	5	13
<i>Panicum virgatum</i>	Switchgrass	2.5	6.5
Total =		40	104

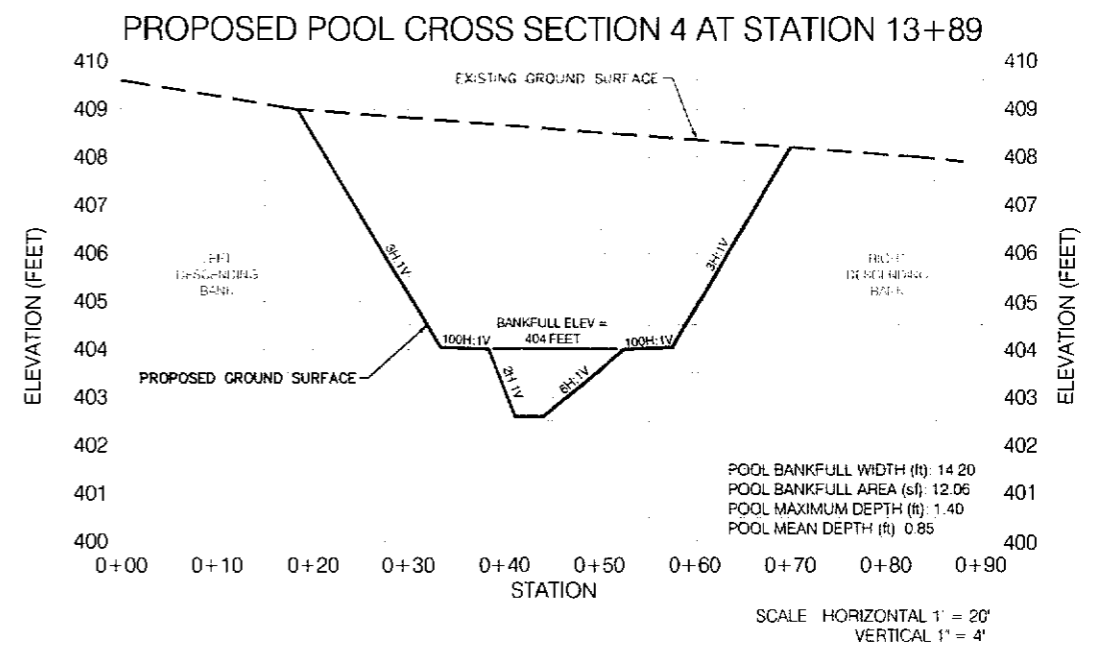
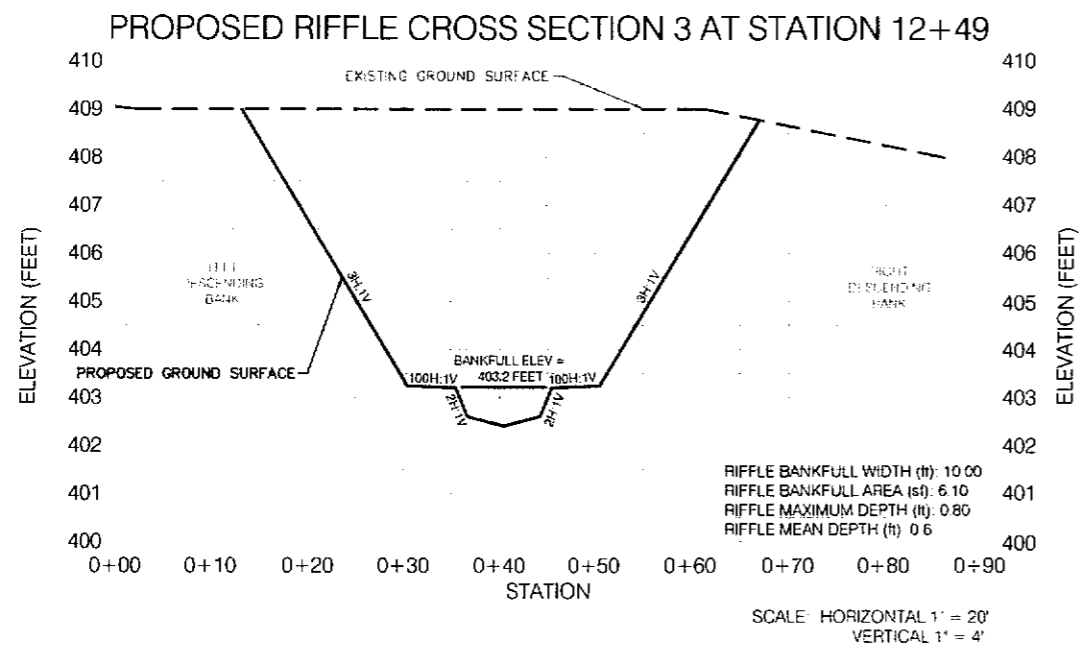
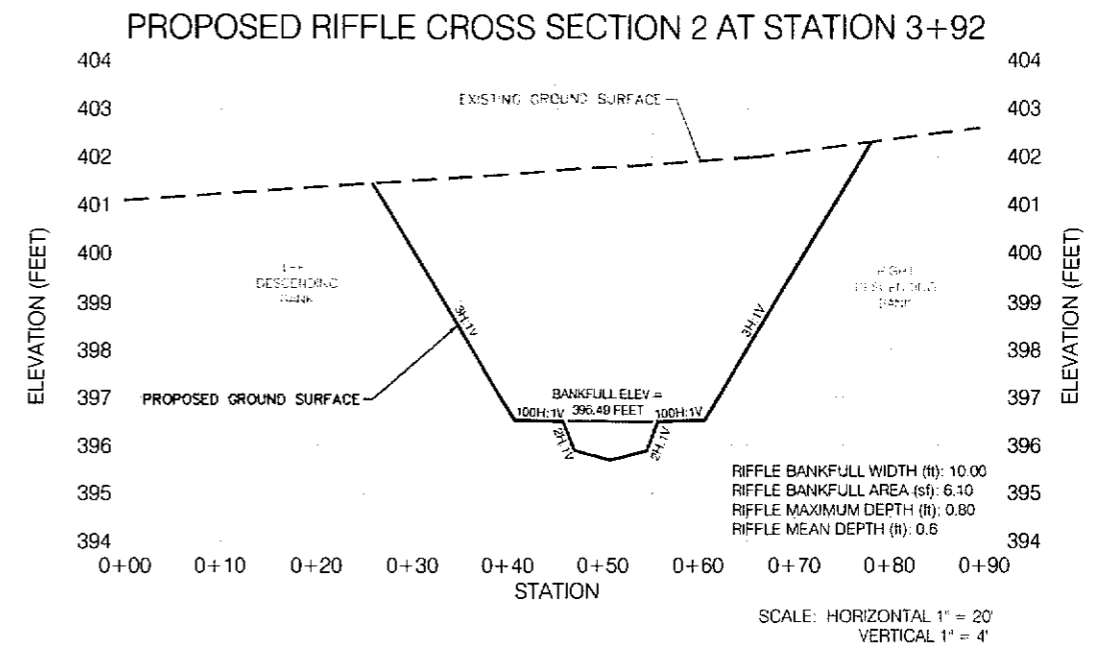
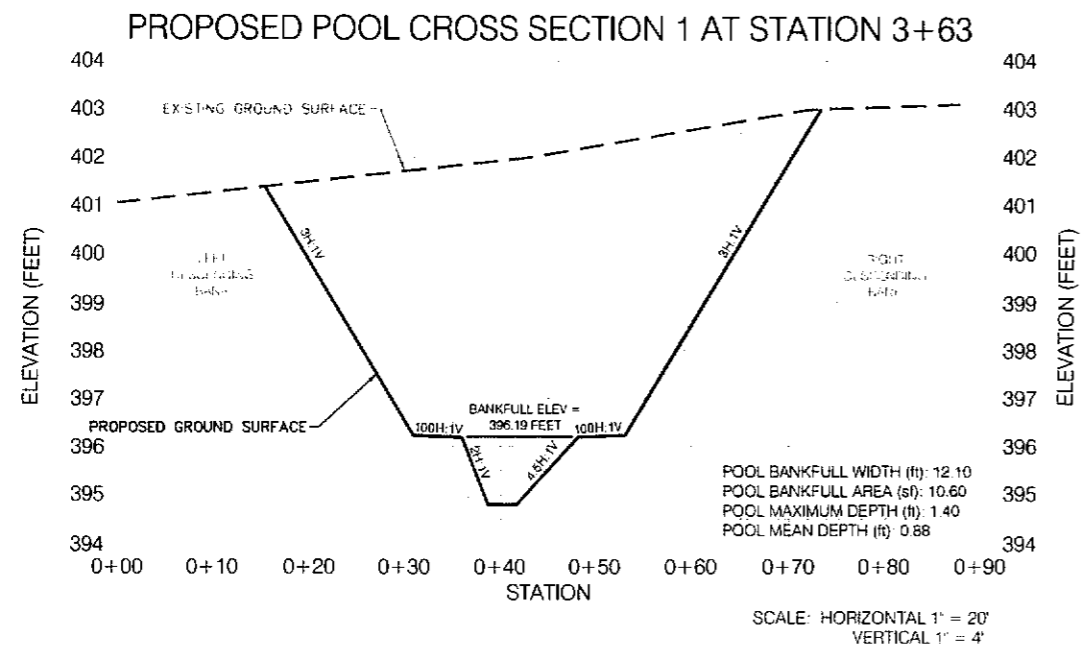
* Areas disturbed during stream construction will be seeded with the seed mixtures outlined above at a rate of 40 pounds per acre.
- Comparable native species may be substituted.

Table 2 - Riparian Zone Native Tree Planting List
Cayman Ridge Development Project
Vanderburgh County, Indiana

Scientific Name	Common Name	Quantity
<i>Diospyros virginiana</i>	Persimmon	74
<i>Juglans nigra</i>	Black Walnut	74
<i>Quercus alba</i>	White Oak	74
<i>Quercus pelustris</i>	Pin Oak	75
<i>Quercus rubra</i>	Northern Red Oak	74
<i>Quercus shumardii</i>	Shumard Oak	74
<i>Ulmus americana</i>	American Elm	75
Total =		520

Notes:
1. Rows of native trees and shrubs will be planted along each restored streambank on 15-foot centers. Trees in each row will be staggered.
2. Comparable native species may be substituted.

<p>CAYMAN RIDGE DEVELOPMENT VANDERBURGH COUNTY, INDIANA</p>	<p>REDWING ECOLOGICAL SERVICES, INC.</p>	<p>PROPOSED PLANTING PLAN</p>
REVISED DATE: 01-15-15	DRAWN BY: BMB	FIGURE 10



CAYMAN RIDGE DEVELOPMENT
VANDERBURGH COUNTY, INDIANA



INTERMITTENT STREAM 1 -
PROPOSED CROSS
SECTIONS